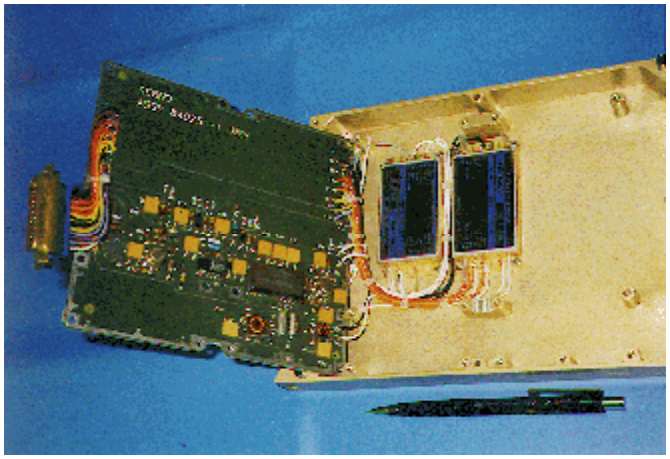
Advanced Power Regulator Developed for Spacecraft

The majority of new satellites generate electrical power using photovoltaic solar arrays and store energy in batteries for use during eclipse periods. Careful regulation of battery charging during insolation can greatly increase the expected lifetime of the satellite. The battery charge regulator is usually custom designed for each satellite and its specific mission. Economic competition in the small satellite market requires battery charge regulators that are lightweight, efficient, inexpensive, and modular enough to be used in a wide variety of satellites. A new battery charge regulator topology has been developed at the NASA Lewis Research Center to address these needs.

The new regulator topology uses industry-standard dc-dc converters and a unique interconnection to provide size, weight, efficiency, fault tolerance, and modularity benefits over existing systems. A transformer-isolated buck converter is connected such that the high input line is connected in series with the output. This "bypass connection" biases the converter's output onto the solar array voltage. Because of this biasing, the converter only processes the fraction of power necessary to charge the battery above the solar array voltage. Likewise, the same converter hookup can be used to regulate the battery output to the spacecraft power bus with similar fractional power processing.

The advantages of this scheme are

- Because only a fraction of the power is processed through the dc-dc converter, the single- stage conversion efficiency is 94 to 98 percent.
- Costly, high-efficiency dc-dc converters are not necessary for high end-to-end system efficiency.
- The system is highly fault tolerant because the bypass connection will still deliver power if the dc-dc converter fails.
- The converters can easily be connected in parallel, allowing higher power systems to be built from a common building block.



Photovoltaic Regulator Kit Experiment.

This new technology will be spaceflight tested in the Photovoltaic Regulator Kit Experiment (PRKE) on TRW's Small Spacecraft Technology Initiative (SSTI) satellite scheduled for launch in 1996. This experiment uses commercial dc-dc converters (28 to 15 Vdc) and additional control circuitry to regulate current to a battery load. The 60-W, 87-percent efficiency converters can control 180 W of power at an efficiency of 94 percent in the new configuration. The power density of the Photovoltaic Regulator Kit Experiment is about 200 W/kg.